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April 12, 2002

Mr. and Mrs. Mel Parker
P.O. Box 609
Libby, MT 59923

SUBJECT: RESPONSE TO CDM COMMENTS
RAINY CREEK RESTORATION PROJECT

Dear Mr. and Mrs. Mel Parker:

Water Consulting, Inc. is in receipt of the CDM April 5, 2002 response to the *Hydrologic Review of Rainy Creek Restoration Project* report prepared by WCI on February 27, 2002. It is the opinion of WCI that the issues raised in our original letter report were not adequately addressed in CDM's April 5, 2002 response. WCI incorrectly referred to Highway 37 as Highway 56 in the February 27, 2002 hydrologic review of Rainy Creek. We apologize for any confusion this may have caused.

1.0 FLOW RATE

The method used to compute the flood series and occurrence probability is a widely accepted methodology endorsed by numerous state and federal government agencies, including the USGS, Natural Resources Conservation Service, U.S. Forest Service, and Montana Department of Transportation.

The regression equations were provided in WCI's original letter report and are included below in Table 1. In response to CDM's request for additional data used to support these calculations, weighted mean annual precipitation and basin size were calculated to be 30-inches and approximately 17.3 mi^2, respectively.

Table 1. Results of USGS Regional Equations, Rainy Creek

$Q_2 = 0.042\, A^{0.94} P^{1.49} = 97$ cfs
$Q_{10} = 0.234\, A^{0.90} P^{1.25} = 214$ cfs
$Q_{25} = 0.379\, A^{0.87} P^{1.19} = 258$ cfs
$Q_{50} = 0.496\, A^{0.86} P^{1.17} = 306$ cfs
$Q_{100} = 0.615\, A^{0.85} P^{1.15} = 344$ cfs

This area of northwest Montana is known for its dynamic flooding potential. Rainy Creek is not an exception. A majority of the precipitation is deposited in the form of a winter snowpack that melts in response to warmer mean daily temperatures and rain-on-snow events between November and June in most years. The selected project design flow was based solely on assumption, anecdotal information, and no scientific justification was provided by CDM for its selection. In their April 5, 2002 response to Mr. John McGuiggin, CDM admits that they "did not evaluate numerous flow rate scenarios for Rainy Creek" and that the basis for determining the design flow rate was based on the assumption that the previous 48-inch culvert on Mr. Parker's property had not been observed flowing at full hydrologic capacity in the past. Therefore, a flow rate of 90 cfs was selected, which conservatively assumes the culvert flowing full. The following points are made in regards to the selected flow rate:

- The previous crossing on Mr. Parker's property was a 42-inch CMP, not a 48-inch CMP as indicated in CDM's April 5, 2002 response. As stated in Mr. Parker's March 6, 2002 response to Mr. Timothy Wall, the 42-inch culvert on the property was flowing at full capacity with a 3-ft. headwater during a spring rain-on-snowmelt event in 1996. Based on hydraulic modeling of this storm event passing through the culvert, a discharge of 100 cfs is computed (see attachment, results of AutoCAD LDD Culvert Calculator). This contradicts CDM's assumed discharge of 90 cfs, as noted in John McGuiggin's January 14, 2002 letter to Melvin and Lerah Parker.

- Since CDM "did not evaluate numerous flow rate scenarios for Rainy Creek", it is apparent that the culvert installed on Mr. Parker's property was designed to convey only slightly more than the two-year storm event (with a 3-ft. headwater). Additionally, the active channel was constructed with 43% less cross-sectional area than necessary to convey the bankfull discharge within an appropriate range of bankfull velocity. This reduction in area will result in mean channel velocities exceeding 7.0 feet/second in the main channel. The existing bed material and profile form is not competent to withstand shear stress produced even during the bankfull flood event. Channel boundary stress produced during bankfull discharge and greater will be sufficient to entrain a majority of the streambed particles. Without grade control or properly sized and placed rip-rap, channel incision will likely ensue, resulting in failure of the rip-rap toe and significant downstream sedimentation.

Potential impacts to water quality and fishery resources are unacceptable risks given the host of threatened and endangered fish species that occupy this section of the middle Kootenai River. Design flow and hydraulic calculations must be incorporated into a project design of this scope and complexity. To do otherwise is negligent and hazardous to both the on-site natural resources and downstream resources.

2.0 CHANNEL GEOMETRY

The constructed channel is undersized in terms of capacity and no consideration was made for grade control and energy dissipation. As previously noted in Section 1.0, under current conditions, the existing bed material is not competent to resist boundary shear stresses generated during even the bankfull flow. Increasing the cross-sectional area and providing an adequate floodplain to convey flows of greater magnitude, combined with grade control and adequately sized and placed rip-rap will be essential to ensure the long-term stability of the project area.

In their April 5, 2002 letter to Mr. John McGuiggin, CDM indicated that they are "unaware of any pre-restoration survey and assessment" of Rainy Creek in the vicinity of the project area. WCI questions how a design for restoration of the stream corridor was developed without a detailed survey of the pre-restoration channel? If the EPA, Volpe or CDM did not conduct a pre-restoration site survey, what was the basis or foundation for the design of the restoration project? This seems to violate standard engineering practices.

2.1 REFERENCE REACH CHANNEL GEOMETRY

To evaluate the as-built channel dimensions, specific data on stream channel dimension, pattern, and profile was collected on a reference stream reach located approximately 1.2 miles upstream of the Parker property. The valley slope, channel materials, and bed slope of the reference reach was consistent with measurements made of Rainy Creek on the Parker property. Additionally, the bankfull channel width/depth ratios of the reference reach (7.9) and Parker reach (7.3) were very similar, (even though the design cross-sectional area of the Parker reach was reduced by 43%). Using the Rosgen classification methodology, the reference reach and Parker reach would classify as B4a channel types (Rosgen 1996). When stream types associated with a bankfull width/depth ratio, slope, and channel materials are similar to the streams from which the hydraulic geometry was derived, extrapolation of these relations is appropriate for design purposes (Rosgen 1998. Presented at American Society of Civil Engineers, Denver, CO). As such, the reference reach was suitable to conduct a comparative tool for evaluating as-built channel dimensions on the Parker property.

Additionally, Mr. Parker provided pre-restoration photos of Rainy Creek to WCI to assist in their review of pre project conditions and stream type delineation. All of the supporting data and information used to support the conclusions in the WCI February 27, 2002 letter report was provided to Mr. Paul Peronard. Longitudinal profiles and cross-section hydraulic analyses for both the reference reach and project area were included as attachments to the letter report.

3.0 LONGITUDINAL PROFILE

CDM's response of April 5, 2002 notes "the slope and creek bed geometry of Rainy Creek were not modified during the emergency removal phase of asbestos remediation work in Libby, except from impacts of vegetation removal". Based on review of the "restored" project area, it is evident that during construction, placement of rip-rap reduced the cross-sectional flow area of the channel by as much as 43%. Placement of rip-rap, according to John McGuiggin's letter of January 14, 2002 to Mr. Melvin and Lerah Parker, indicated that the "riprap had been keyed into the streambed, as shown on the restoration design drawings".

Based on the WCI field review, it was evident that encroachment from rip-rap on the creek banks displaced several feet of the cross-sectional area. This is particularly evident when one compares the as-built longitudinal profile of the project area to the longitudinal profile surveyed on the reference reach. As described in WCI's February 27, 2002 letter report, streams of this gradient class naturally dissipate energy through steps and pools and the step frequency is directly proportional to channel width and indirectly proportional to slope. If the pre restoration creek bed geometry of Rainy Creek was not modified during removal of asbestos, WCI questions why these natural bed features are not currently present in the Parker reach. Removal of vegetation, in our opinion, is not an action that would result in displacement of step-pool features in a gravel-cobble dominated stream such as Rainy Creek. Proper keying of riprap inevitably results in disturbance to the streambed, especially in narrow stream types. Therefore, the statement that only impacts resulting from vegetation removal occurred, are not accurate.

4.0 RIP-RAP SIZING AND INSTALLATION

CDM indicated that their onsite evaluation concluded that the north bank rip-rap is appropriately sized and has been appropriately placed. We do not concur with their conclusion. As noted in WCI's letter report of February 27, 2002 (page 4, Table 3), as-built sampling of both the north and south banks was conducted to determine the particle size distribution of bank placed rip-rap. As noted in Table 2, the median particle size of the north bank does not meet the D_{50} particle size specified in the MDOT Class II rip-rap standards (see Table 2). As such, the north bank rip-rap was not appropriately sized and the placement of the material warrants additional investigation in the form of test pits to confirm keying of the rip-rap.

Table 2
Comparison of Median Particle Sizes (D_{50})
Rainy Creek Restoration Project

MDOT Standard	North Bank	South Bank
1.32-ft.	1.10-ft.	.59-ft.

WCI concurs with CDM that MDOT Class II rip-rap is suitable for the site. However, the existing gradation is not suitable since the following design parameters were not accurately engineered or constructed:

- Channel cross-sectional geometry, and
- Longitudinal profile, including step-pool frequency.

5.0 CULVERT CAPACITY AND FISH PASSAGE

According to CDM, "there is no justification for a larger culvert to be installed on the Parker property." The information presented in Section 1.0 Flow Rate and in Sections 1.0 and 4.0 of WCI's letter report dated February 27, 2002 is sufficient to support the justification for a larger culvert. The maximum capacity of the replaced culvert, with a calculated headwater of 3.0-ft. at the inlet, is 120 cfs (see WCI letter report dated February 27, 2002). The existing crossing is capable of passing less than the 10-year recurrence interval flood. Under flow conditions exceeding 120 cfs, over-topping of the road prism will occur and likely result in significant erosion of the road fill and/or failure of the entire road prism. The effects would include a significant pulse and delivery of fine-grained sediments to lower Rainy Creek and the Kootenai River, and significant impacts to the "restored" channel, including reduced cross-sectional area. Given the armored nature of the streambanks, reduced cross-sectional area, and lack of grade control, the downstream channel would like incise to accommodate the increase in sediment supply and potentially initiate a knickpoint and headwater erosion of the channel bed.

These effects, including those to fish passage ability, are unacceptable risks and can be avoided by increasing the conveyance capacity of the crossing. Increasing the culvert size to accommodate a reasonable range of flows is very inexpensive relative to the total cost of this project. Considering the host of federally endangered and threatened fish species present in the Kootenai River, improving the capacity of the crossing to minimize potential for road fill failure and to provide fish passage must be considered primary objectives for a project of this nature.

6.0 WATER RIGHTS

WCI will supplement this response with the appropriate dimensions and depth of the POD. However, it is our opinion that the costs to re-establish and design the POD control is the responsibility of Volpe Center since the POD was in suitable operation prior to restoration activities.

7.0 SUMMARY

It is evident that the basis of the channel geometry, rip-rap sizing, and culvert sizing was an assumed discharge that equates to less than the estimated bankfull or two-year recurrence interval discharge. The design does not take into consideration floods of greater magnitude, including the Q_{10}, Q_{25}, Q_{50}, and Q_{100}. A properly designed project would have consisted of two-stage channel consisting of a primary or bankfull channel designed to convey the normal annual flows (bankfull) constructed within a floodplain to carry floods of greater magnitude. In order for Rainy Creek to maintain sediment transport, debris passage, and stream flow conveyance during normal runoff events, it must have a consistent, specific cross-sectional area. The width/depth ratio and other hydraulic parameters are balanced with the gradient to provide enough sediment transport capacity transport the available sediment. For Rainy Creek to maintain its' cross-sectional area during floods greater magnitude than the bankfull discharge, it must have a sufficient floodplain so that all flows are not confined within the bankfull channel.

Providing an adequate bankfull channel and floodplain to convey flows of greater magnitude must be considered when designing stream crossings and natural channels such as Rainy Creek. Failure to incorporate the range of flows expected for Rainy Creek will only result in higher risk of failure and long-term maintenance problems.

As previously recommended, WCI would welcome the opportunity to discuss these matters in the field at the project area at the convenience of Volpe and CDM. Please let us know if we can be of further assistance in this matter.

Sincerely,

Water Consulting, Inc.

John M. Muhlfeld

John M. Muhlfeld
Hydrologist

cc: Kirk Sullivan, NRCS
Mike Hensler, MFWP
Doug McDonald, USACOE
Dean Yashan, MDEQ
Mike Justice, Lincoln Conservation District
Timothy B. Wall, CDM Federal Programs Corporation
John McGuiggin, Volpe
Paul Peronard, EPA

tmp#28

Culvert Calculator

Entered Data:

Shape	Circular
Number of Barrels	1
Solving for	Headwater
Chart Number	2
Scale Number	3
Chart Description	CORRUGATED METAL PIPE CULVERT
Scale Decsription	PIPE PROJECTING FROM FILL
Overtopping	Off
Flowrate	60.0000 cfs
Manning's n	0.0240
Roadway Elevation	10.2850 ft
Inlet Elevation	3.2850 ft
Outlet Elevation	0.0000 ft
Diameter	3.5000 ft
Length	45.0000 ft
Entrance Loss	0.0000
Tailwater	3.5000 ft

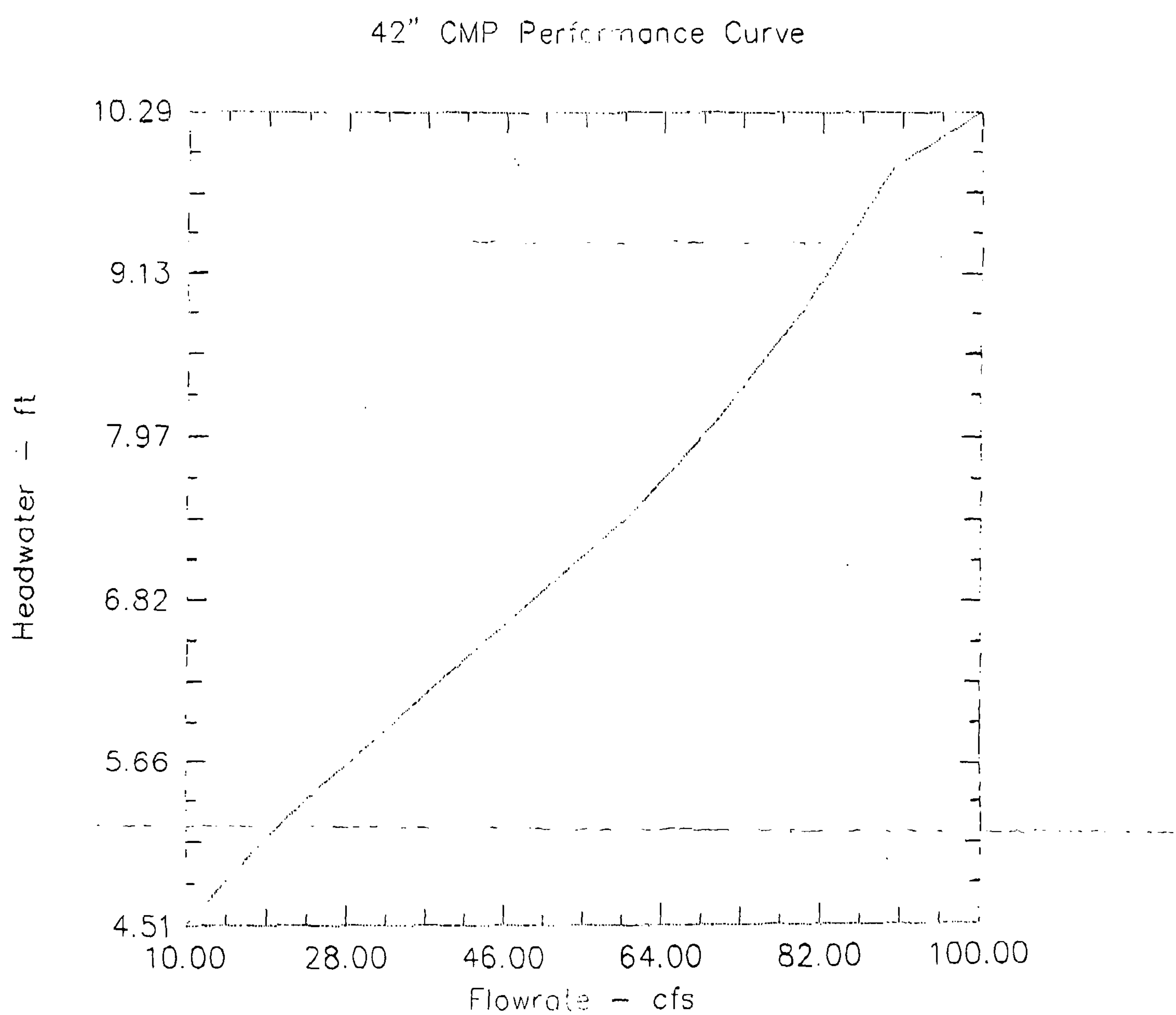
Computed Results:

Headwater	7.4122 ft Inlet Control
Slope	0.0730 ft/ft
Velocity	14.5295 fps

Messages:

Computing Inlet Control headwater.
Solving Inlet Equation 26.
Solving Inlet Equation 28.
Headwater: 11.0214 ft

DIS-CHARGE Flow cfs	HEAD-WATER ELEV. ft	INLET CONTROL DEPTH ft	OUTLET CONTROL DEPTH ft	FLOW TYPE	NORMAL DEPTH ft	CRITICAL DEPTH ft	OUTLET VEL. fps	OUTLET DEPTH ft	TAILWATER VEL. fps	TAILWATER DEPTH ft
10.00	4.51	1.22	0.00	NA	0.62	0.96	8.74	0.62	0.00	3.50
20.00	5.18	1.89	0.00	NA	0.87	1.37	10.70	0.87	0.00	3.50
30.00	5.76	2.48	0.00	NA	1.07	1.69	12.02	1.07	0.00	3.50
40.00	6.32	3.04	0.00	NA	1.25	1.97	13.02	1.25	0.00	3.50
50.00	6.87	3.58	0.00	NA	1.41	2.21	13.84	1.41	0.00	3.50
60.00	7.41	4.13	0.00	NA	1.56	2.43	14.53	1.56	0.00	3.50
70.00	8.07	4.79	0.00	NA	1.70	2.62	15.12	1.70	0.00	3.50
80.00	8.87	5.59	0.00	NA	1.84	2.79	15.63	1.84	0.00	3.50
90.00	9.89	6.60	0.00	NA	1.98	2.94	16.07	1.98	0.00	3.50
100.00	10.29	7.00	0.00	NA	2.11	3.07	16.46	2.11	0.00	3.50


42" CMP Performance Curve
Headwater – ft
10.29
9.13
7.97
6.82
5.66
4.51
10.00
28.00
46.00
64.00
82.00
100.00
Flowrate – cfs